

# PATENT ABSTRACTS OF JAPAN

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## **(54) METHOD FOR MELTING METALLIC SCRAP AND APPARATUS THEREFOR**

(57)Abstract:

**PURPOSE:** To melt a high purity metal at a low cost by oxidizing and removing impurities in metallic scrap with high temp. exhaust gas in a melting furnace and charging the treated metallic scrap into the melting furnace, at the time of producing the high purity molten metal by using the metallic scrap containing the impurities as the raw material.

**CONSTITUTION:** The steel scrap 1, etc., is charged into a vertical furnace 4 as the raw material from a charging hole 5 and, at the same time, coke as fuel and lime stone as slag-making agent are charged from the top part of the vertical furnace 4. The steel scrap is melted by feeding hot blast from lower tuyeres 10 and tapped as molten iron from an iron tapping hole 11. In this case, the steel scrap 1 is charged into a preheating furnace 3 as a carrying path for steel scrap 1 from a charging hole 2 and the oxidizing high temp.

exhaust gas from the melting furnace 4, is introduced into the preheating furnace 3. The exhaust gas is heated to a high temp. with an afterburner 6, and Cu, Sn, Ni, Al, etc., in the steel scrap surface are oxidized and embrittled, and also, separated from the steel scrap by vibrating with separating mechanism 7 and removed as the impurities 8 from the separating mechanism 9. Thus, only the high purity scrap is supplied into the melting furnace 4 and the high purity molten iron is tapped.

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[Claim 1]A dissolving method of a metal scrap preceding inserting a metal scrap in a fusion furnace, and carrying out separation removal of the impurity adhering to a metal scrap in a process of preheating a metal scrap using exhaust gas of a fusion furnace.

[Claim 2]A dissolving method of the metal scrap according to claim 1 which gives vibration to a metal scrap and separates an impurity.

[Claim 3]A dissolving method of the metal scrap according to claim 1 which classifies a metal scrap and an impurity separated from there, and supplies a metal scrap to a fusion furnace selectively.

[Claim 4]A dissolving method of the metal scrap according to claim 1 which controls oxygen potential and temperature in exhaust gas of a fusion furnace in a range in which an impurity adhering to a metal scrap oxidizes.

[Claim 5]In a dissolving device of a metal scrap which combined a preheating oven using exhaust gas of this fusion furnace with a fusion furnace of a metal scrap, A dissolving device of a metal scrap which installs a judgment mechanism which classifies a separation mechanism which gives vibration to a metal scrap and forces it exfoliation of an impurity and a metal scrap, and an impurity, and supplies a metal scrap to a fusion furnace selectively in this preheating oven.

[Claim 6]A dissolving device of the metal scrap according to claim 5 which makes at least a part of preheating oven a carrying path which leads a metal scrap to a fusion furnace.

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#### [Detailed Description of the Invention]

[0001]

[Industrial Application]This invention describes especially improvement of the art of dissolving a metal scrap after preheating a metal scrap using the exhaust gas of the fusion furnace of a metal scrap, about the dissolving method of a metal scrap with low impurity concentration, and its device.

[0002]

[Description of the Prior Art]In recent years, the yield of the metal scrap represented by iron increases and recycling of this metal scrap is attracting attention from a viewpoint of environmental protection or a metal reduce manufacturing cost. For example, in iron, the steel scrap etc. by which it is generated with superannuation of \*\*\*\*\* which cooled molten iron and this which obtained it by carrying out smelting reduction of the iron ore with the shaft furnace as an iron source for steel manufacture, and was solidified or the steel scrap by which it is generated at the time of processing of a ferrous material and a building, a machine product, etc. are used conventionally.

[0003]Since it faces in a steel-manufacture stage using these iron sources and molten iron and \*\*\*\*\* are using iron ore as the base, the impurity concentration contained is low and it is possible to obtain a high-definition product, but. It not only needs great energy for carrying out smelting reduction of the iron ore, but there is disadvantage which needs

large-scale plant-and-equipment investment called prior processing, shaft furnaces, and converters of a raw material, such as iron ore, as iron making and a steelworker, in view of the whole.

[0004]On the other hand, when a steel scrap is used as an iron source, as compared with the case where iron ore is made into an iron source, it has the advantage that energy consumption for reduction heat can be lessened, that prior processing of a raw material can be simplified, and that still larger-scale equipment and device become unnecessary.

[0005]As an example which uses such a steel scrap as an iron source, The CONSTEEL process of the statement is known by Iron and SteelEngineer, vol.62 (1985), No.10, an EOF process given in p.16 and Iron and Steelmaker, May 1986, and P.37.

[0006]Although these methods have attained the advantageous conditions in thermal efficiency also to preheating of a scrap using the exhaust gas of a steel furnace, In consideration of the impurity which is intermingled with a scrap and supplied to a preheating oven, the oxide further generated in the preheating process of a scrap, and peeled material being carried in in a steel furnace, it does not have the function to remove such impurities and oxides, and peeled material. For this reason, when the product quality demanded is high, it will be necessary to use an expensive scrap with low impurity concentration as an iron source, as a result, the main material cost increases, and economical operation becomes difficult.

[0007]

[Problem(s) to be Solved by the Invention]Then, the purpose of this invention is to provide the dissolving device which suits in favor of the method of dissolving the metal scrap with low impurity concentration which prevented mixing of the impurity to the fusion furnace of a metal scrap, or a metallic oxide, and this method.

[0008]

[Means for Solving the Problem]This invention is a dissolving method of a metal scrap preceding inserting a metal scrap in a fusion furnace, and carrying out separation removal of the impurity adhering to a metal scrap in a process of preheating a metal scrap using exhaust gas of a fusion furnace.

[0009]Giving vibration to a metal scrap and separating an impurity here, a metal scrap, and an impurity separated from there are classified, It is advantageous in operation to control oxygen potential and temperature in exhaust gas of to supply a metal scrap to a fusion furnace selectively and a fusion furnace in a range in which an impurity adhering to a metal scrap oxidizes.

[0010]In a dissolving device of a metal scrap in which this invention combined a preheating oven using exhaust gas of this fusion furnace with a fusion furnace of a metal scrap, It is a dissolving device of a metal scrap which installs a judgment mechanism which classifies a separation mechanism which gives vibration to a metal scrap and forces it exfoliation of an impurity and a metal scrap, and an impurity, and supplies a

metal scrap to a fusion furnace selectively in this preheating oven.

[0011]Here, as for at least a part of preheating oven, it is advantageous to consider it as a carrying path which leads a metal scrap to a fusion furnace.

[0012]An impurity adhering to a metal scrap adheres to the surface of a metal scrap, or means an oxide and peeled material which are further generated in a preheating process of a scrap as well as an impurity which is intermingled with a scrap and supplied to a preheating oven.

[0013]Next, a steel scrap is explained to an example in detail with reference to drawing 1 about a dissolving method of a metal scrap of this invention. First, the steel scrap 1 is dissolved using corks and limestone which threw into the preheating oven 3 the steel scrap 1 which is an insertion raw material from the entrance slot 2, were transported to the fusion furnaces 4, such as a cupola and an electric furnace, were inserted in the fusion furnace 4 by making this preheating oven 3 into a carrying path, and were inserted in separately.

[0014]It is the composition which forms the preheating oven 3 from the entrance slot 2 between the feed ports 5 of the steel scrap 1 in the fusion furnace 4, and serves also as a carrying path of the steel scrap 1 here, Exhaust gas of the fusion furnace 4 is drawn in the preheating oven 3 from the feed port 5, and sensible heat of this exhaust gas and combustion heat obtained by burning exhaust gas with the afterburner 6 further installed in the feed port 5 realize preheating of the steel scrap 1 and partial oxidation.

[0015]The preheating oven 3 is provided with the separation mechanism 7, and the impurities 8, such as an oxide film formed in the surface by preheating of an impurity and a steel scrap adhering to a steel scrap, are made to separate from a steel scrap.

[0016]Here, as the separation mechanism 7, a mechanism in which vibration is given to the preheating oven 3, for example is recommended. That is, while transporting the steel scrap 1 to the fusion furnace 4 by vibrating the preheating oven 3 used as a carrying path, vibration is given to the steel scrap 1 and the impurity 8 is made to separate from a steel scrap. As a mechanism in which vibration is given, exciting force by rotation of a vibrating motor or a cam is used.

[0017]Subsequently, with the judgment mechanism 9 formed in the appearance side of the preheating oven 3, the steel scrap 1 and the impurity 8 which were separated are classified, and only the steel scrap 1 is inserted in the fusion furnace 4. Since grain refining of the impurity was carried out to preheating of the steel scrap 1 by vibration, a lattice which can classify an impurity by particle diameter difference with a steel scrap was used especially for this judgment mechanism 9. In addition, since bulking density (if it is the same particle diameter unit weight) of a steel scrap and an impurity is different, a method of spraying gas on a mixture of a steel scrap and an impurity, and classifying with kinetic energy (wind pressure) of this gas may be adopted.

[0018]And an impurity the removed steel scrap 1 from the upper part of the fusion furnace 4, It inserts in continuously or semi-continuously into a furnace with corks and limestone, and air or oxygen enriched air is supplied in a furnace from the tuyere 10 provided in the lower part of the fusion furnace 4, the steel scrap 1 is dissolved, and molten iron is taken out from the iron tapping hole 11.

[0019]Although a conveyance face of a steel scrap in a preheating oven was leveled and it had composition transported to the fusion furnace side by vibration in an example of drawing 1, it is also possible to aim at a transfer of a steel scrap by turning a conveyance face to a fusion furnace and leaning it.

[0020]

[Function]Now, in order that the pig-iron manufacturing method which uses a steel scrap as an iron source may not return iron oxide and may just supply heating and heat required for the dissolution as compared with the method of using iron ore, such as a shaft furnace method, there is little energy consumption, it ends and is economical.

[0021]In order to use a vertical furnace by a pig-iron manufacturing process (scrap melting process), cheap charcoal material, such as corks, can be used as a heat source (energy source), since it is possible to, make characteristic top emission temperature of a furnace into lower order in addition, thermal efficiency can be improved, and it is advantageous by both sides of energy consumption and cost. Of course, electrical energy may use the usual electric furnace for a pig-iron manufacturing process (scrap melting process) in cheap location. It is possible by connecting the preheating oven of a metal scrap with the fusion furnace of this steel scrap to exploit the exhaust gas energy from a fusion furnace for preheating of a metal scrap directly.

[0022]It poses a problem here that the impurity adhering to a metal scrap and the oxide further generated in the preheating process in a preheating oven are impossibly carried in in a fusion furnace.

[0023]So, in this invention, only a steel scrap is selectively inserted in to a fusion furnace by separating and classifying the impurity which intermingled or adhered to the steel scrap, the oxide chemically generated in the preheating process of a steel scrap, the peeled material generated physically, etc. from a steel scrap in a preheating process. As a result, even if it is a case where a cheap scrap with high impurity concentration is used, it becomes possible to make comparatively into lower order impurity concentration in the molten iron obtained from a fusion furnace, and reduction of the main material cost can be aimed at. It combines, and since impurity concentration in the molten iron obtained from a fusion furnace is made to lower order and the impurity removing process like a steelworker can be simplified, reduction of whole refinement cost is also realized as iron making and a steelworker.

[0024]It is based on the following reasons that it dissociates and an impurity may be classified as an oxide or peeled material in a preheating process here. That is, generally the impurities of a steel scrap are plating tunics, such as Cu in the scrap surface, Sn, and

Cr.

In a preheating process, by these plating layers' oxidizing and becoming weak, it becomes a wafer and exfoliates.

Since similarly aluminum oxidizes and it becomes  $\text{Al}_2\text{O}_3$  when metal aluminum is intermingled for a scrap, it is easy to separate this from a steel scrap.

[0025]On the other hand, although nickel plating layer cannot oxidize easily, since it has adhered on the surface of a steel scrap, and also iron itself oxidizes and it exfoliates as scale, nickel also becomes that it is easy to separate from iron. That is, since the scrap surface will oxidize and it will become easy to exfoliate as scale if a steel scrap is preheated in an elevated temperature and the atmosphere of an oxidizing quality, even if the nonferrous metal itself does not oxidize, it becomes easy to dissociate as a surface affix.

[0026]By performing prior processing in which it preheats vibrating a steel scrap when various experiments are extensively conducted on separation of the impurity from a steel scrap in the above-mentioned preheating process. Most impurities adhering to the impurity and the steel scrap surface which are intermingled in a steel scrap are separable, Separating [ an impurity ]-more efficiently \*\* newly became clear by controlling the oxygen potential and temperature of exhaust gas of a fusion furnace in the range in which the impurity adhering to a metal scrap oxidizes.

[0027]

[Example]According to the place shown in drawing 1, by the shredder scrap of 25 - 200 mm, size dissolved the steel scrap whose total quantity of an impurity, i.e., Cu, nickel, Cr, and Sn is 0.45wt%, and manufactured the pig iron.

[0028]Capability used the cupola of 5 t/h, and operating conditions are blast weight:  $80\text{Nm}^3/\text{min}$ , and amount of oxygen:  $1.5\text{Nm}^3/\text{min}$ , and supplied blast furnace coke whose size is 25-75 mm to the fusion furnace by 12 kg/min. The preheating oven of the steel scrap was burned with the afterburner, and the exhaust gas from a fusion furnace was introduced into it so that preheating gas temperature might be 800 \*\*.

[0029]When operation under the above conditions was performed, the total quantity of the impurity in the molten iron obtained from the cupola, i.e., Cu, nickel, Cr, and Sn decreased to 0.07wt%, and the extraction ratio of the impurity was about 85%.

[0030]Although the equipment and operating condition same as comparison as the above-mentioned example were followed, it operated by stopping the separation mechanism 7 of the impurity installed in the preheating oven 3. As a result, the total quantity of the impurity in the molten iron obtained from the cupola, i.e., Cu, nickel, Cr, and Sn stopped at reduction up to 0.43wt%, and the extraction ratio of the impurity was only about 5%.

[0031]

[Effect of the Invention]In [ face dissolving, after preheating a steel scrap combining a preheating oven to the fusion furnace of a metal scrap according to this invention, and ] a

preheating process, Since only a steel scrap can be selectively supplied to a fusion furnace by separating the impurity intermingled for a metal scrap, and the impurity generated in the preheating process of a metal scrap from a metal scrap, manufacture of molten iron with low impurity concentration is attained.

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